21
ESL 34

Operating Instructions

VACUUM-TUBE VOLTMETER

Type TF 1300

MARCONI INSTRUMENTS LIMITED, ENGLAND

341

OPERATING INSTRUCTIONS

for

VACUUM TUBE VOLTMETER

TYPE TF 1300

CONTENTS

1. DESCRIPTION

GENERAL ..... Sect. 1.1.
DESIGN DETAILS ..... Sect. 1.2.

2. INSTALLATION

MAINS INPUT ARRANGEMENTS ..... Sect. 2.1.

3. OPERATION

PRELIMINARIES ..... Sect. 3.1.
A.C. MEASUREMENTS ..... Sect. 3.2.
D.C. MEASUREMENTS ..... Sect. 3.3.
OHMS MEASUREMENTS ..... Sect. 3.4.

4. MAINTENANCE

GENERAL ..... Sect. 4.1.
ACCESS TO COMPONENTS ..... Sect. 4.2.
The Probe Diode ..... Sect. 4.2.1.
WORKING VOLTAGES ..... Sect. 4.3.
REPLACEMENT OF VALVES ..... Sect. 4.4.
REPLACEMENT OF VOLTAGE STABILIZER CELLS ..... Sect. 4.5.
ADJUSTMENT OF INTERNAL PRESET COMPONENTS ..... Sect. 4.6.
Adjustment of D.C. Zero Preset ..... Sect. 4.6.1.
Stabilization of A.C. Zero ..... Sect. 4.6.2.
Adjustment of D.C. Full-Scale Deflection ..... Sect. 4.6.3.
Adjustment of A.C. Full-Scale Deflection ..... Sect. 4.6.4.

DRAWINGS

MAINS INPUT CONNECTIONS DIAGRAM
(follows page 6) ..... TLC 28392
A.C. PROBE CHARACTERISTICS
(follows page 9) ..... TLC 28390

FUNCTIONAL DIAGRAM ..... TLC 28142

CIRCUIT DIAGRAM ..... TC 27970
(two sheets)

DECIBEL CONVERSION TABLE ..... OM G-SUPP dB

SCHEDULE OF PARTS SUPPLIED

The complete equipment comprises the following items:-

1. One Vacuum Tube Voltmeter Type TF 1300, complete with attached mains lead, diode probe unit, and d. c. leads, and with valves, etc. as under:

Valves:	One:	Type DA90, Diode.
	Two:	Type 12AU7 (B329), Double Triodes.
	One:	Type 6X4 (U78), Full-Wave Rectifier.
Lamp:	One:	6. 3-volt, 0. 15-amp, M. B. C. Pilot Lamp.
Stabilizers:	Two:	1. 5-volt Cells, A. E. Type 15BC20.

2. One Grounding Clip Type TC 23535/3, to fit Probe Unit.

3. One Instruction Book, EB 1300.

1. DESCRIPTION

1.1. GENERAL

The TF 1300 Voltmeter measures a.c. voltages from 50 mV to 100 volts in the frequency range 20 c/s to 300 Mc/s, d.c. voltages from 0.1 to 300 volts, and resistances from 50 Ω to 5 MΩ. Five ranges are used for a.c. measurements, five for d.c., and two for resistance. For d.c. measurements, provision is made for reversing the meter movement, thus facilitating the measurement of d.c. voltages of unknown or changing polarity.

The meter is direct reading for d.c. as well as a.c. measurements. Its zero is unaffected by changes in the setting of the range switch, and a supply mains variation of 6% will cause a maximum change of 3% of f.s.d. on the lowest a.c. or d.c. range; other ranges remain relatively unaffected.

The mechanical design of the instrument is unorthodox: there is no conventional chassis and all components are mounted on the rear of the sloping front panel, which hinges upwards for ease of servicing. Operational presets are accessible in a case-top recess which is also used for lead stowage. The recess lid hinges back to form a support that allows the instrument to be used, if required, in a 45° sloping position.

1.2. DESIGN DETAILS

The following detailed description is intended to be read in conjunction with the Functional Diagram, Drawing No. TLC 28142 and the Complete Circuit Diagram, Drawing No. TC 27970. Both these drawings are located at the end of the handbook.

Basically the instrument consists of two double-triodes connected to form a four-arm bridge circuit using a meter as an out-of-balance indicator. For a.c. measurements, the input is rectified in a diode probe unit before being applied to the bridge; d.c. voltages are applied directly to the bridge via the d.c. leads. For resistance measurements, the unknown resistance is connected in series with a standard resistor and a stabilized 3-volt d.c. supply; the voltage developed across the unknown resistor is then applied to the bridge circuit. Automatic overload protection for the meter, on both a.c. and d.c. ranges, is provided by the shape of the valve characteristics and the design of the associated circuits.

1.2. (continued)

The probe unit used for a.c. measurements houses the shunt-connected rectifier diode, V1, together with resistor R1 which forms part of the diode load. The remainder of the load resistance, R2 and R3, is contained in the main body of the instrument; the rectified output from the diode, reduced by a factor of 1.3, is taken from R3 and fed to one grid of the double-triode V2 in one arm of the bridge circuit. The second grid of V2 is connected to a circuit designed to compensate for the splash current or initial velocity current of the rectifying diode.

The indicating meter, M1, is connected, via the appropriate range resistors, between the two cathodes of V2. Meter deflection is a function of the voltage difference applied between the two grids of V2. The instrument operates as a peak-responding voltmeter calibrated to read the r.m.s. value of a sinusoidal input.

The splash-current backing-off voltage is made up of two components: a positive stabilized voltage derived from the two stabilizer cells, VS1 and VS2; and an unstabilized negative portion of the h.t. supply. These two components, whose relative levels are set by means of RV8 and RV7 respectively, determine the magnitude of the backing-off voltage and the slope of its change with respect to mains variation.

VS1 and VS2 are nickel-cadmium stabilizer cells. Passage of current through this type of cell sets up an electro-chemical potential between its electrodes; this potential is substantially independent of the current and has a value close to 1.5 volts per cell. The stabilizers have no storage capacity and, therefore, no terminal voltage exists when the applied current is discontinued.

For resistance measurements, the unknown resistor is connected, by means of the DC/Ω and COM leads, in series with the 3-volt stabilized d.c. supply - as used for splash-current balancing in a.c. measurements - and one or other of two standard resistors, R20 and R21. The voltage developed across the unknown resistor is then applied to the bridge circuit via R5 and switch contact S2a-11. The SET OHMS control, RV4, in series with the meter, enables the two resistance ranges to be standardized at full scale when the external connecting leads are open circuited.

The Voltmeter has a built-in power unit using a full-wave valve rectifier. Tappings on the mains transformer primary winding allow operation from any 40- to 100-c/s a.c. supply within the ranges 100 to 150 volts and 200 to 250 volts.

2. INSTALLATION

The Voltmeter is dispatched with all valves in their holders, and ready for use with 240-volt, 40- to 100-c/s supplies, unless it has been otherwise specified at the time of ordering. Adjustment can be made to suit any other supply voltage in the ranges 100 to 150 volts and 200 to 250 volts.

Check, or alter, the supply voltage setting by following the instructions given in Section 2.1 below.

2.1. MAINS INPUT ARRANGEMENTS

The mains transformer has a double-wound primary whose two tapped sections are connected in series for the high (200- to 250-volt) range, or in series-parallel for the low (100- to 150-volt) range.

To gain access to the mains transformer:-

(1) Slacken, but do not remove, the top and bottom screws near the front edge of each side panel.

(2) Remove the two round-head screws at the bottom of the front panel, one below the engraving 'TF 1300' and the other below the serial number.

(3) Swing the complete front panel assembly outwards and upwards from the bottom.

The high or low range is selected by links on the coil of the transformer, as illustrated on Drawing No. TLC 28392 following this page. Selection of intermediate voltages within either range is made by means of fly leads on the transformer tags. These tags are common to both ranges and are, therefore, annotated with two voltages; the applicable voltage depends on the position of the range links.

One fly lead must always be connected to either the '0' or '+10' tag; the other is connected to the tag whose voltage, added to 0 or 10 as appropriate, equals the mains supply voltage. Do not connect the fly leads to the tags marked TAP A or TAP B.

3. OPERATION

3.1. PRELIMINARIES

(1) Set the mechanical zero adjuster on the meter.

(2) Open the lid by lifting its front edge to disengage the spring clip above the meter. Pull out the mains lead and locate it in the slot at the top of one of the side panels.

(3) Before plugging in, be sure the supply voltage tapping is correctly set - see Section 2.1, MAINS INPUT ARRANGEMENTS, for details.

(4) Switch on by turning the Selector switch from the OFF position. Allow the instrument to warm up for at least 10 minutes, and preferably half an hour.

With the lid hinged back to form a support, the Voltmeter may be operated in a sloping position as an alternative to the normal upright one.

3.2. A.C. MEASUREMENTS

The figure numbers refer to the diagram of a.c. probe characteristics, following page 9.

Performance Data

Voltage Range:	0.05 to 100 volts
Accuracy:	±3% of full scale ± 0.02 volt
Input Impedance:	R: see fig. 1 C: 4 μμF
Frequency Range:	20 c/s to 300 Mc/s; see fig. 2

Connections

Use the probe for a.c. measurements, making the 'Lo' connection by a fly lead from the probe earth clip. The higher the frequency, the more important it is to keep this lead as short as possible.

3.2. (continued)

The probe earth clip is a.c. coupled to the Voltmeter chassis, and directly coupled to the COM lead. For l.f. measurements, the COM lead can be used as the 'Lo' connection.

Rough measurements at r.f. may be made without the use of either earth clip or COM lead; the 'Lo' a.c. earth return is made via the coupling capacitor to chassis in the Voltmeter or the self-capacitance between the probe casing and the chassis under test.

Setting Zero

When the instrument has warmed up:-

First, adjust the SET ZERO control on the 3V DC '+' or '-' range with the d.c. leads short-circuited.

Then, adjust the A.C. ZERO control on the 1V AC range with the probe connections short-circuited. This control is fairly sluggish and the meter deflection should be allowed time to stabilize after each adjustment.

Any subsequent small variations in a.c. zero may be offset by means of the SET ZERO control unless it is particularly required to keep the zero setting for the d.c. ranges undisturbed; in this case, use the A.C. ZERO control.

If the zero setting appears to be affected by supply voltage variations, refer to Section 4.6.1 - Stabilization of A.C. Zero.

Indication

The meter is calibrated to read the r.m.s. value of a sinusoidal signal.

When appreciable distortion is present in the signal, the meter reading differs from the r.m.s. by an amount that depends on the magnitude and phase of the harmonics. Where one harmonic predominates, the percentage difference in either direction can be as high as the percentage distortion.

On the higher ranges, the peak value of both simple and complex waveforms is obtained by multiplying the meter reading by 1.414.

3.2. (continued)

Voltage Limitations

The peak voltage applied between the 'Hi' and 'Lo' probe connections must not exceed 450 volts. Allowance must be made for this fact when measuring pulsed signals or a.c. superimposed on d.c.; in the latter case, the peak voltage is given by the d.c. plus the peak a.c.

The peak voltage between the 'Lo' connection and earth must not exceed 250 volts a.c. or 350 volts d.c.

Error due to High Source Resistance

When measuring voltages across a high-resistance source, the meter reads low as a result of the peak clipping effect. The degree of reading error at audio frequencies is shown graphically in Fig. 3. The error increases at higher frequencies, but the effect is of less significance in view of the lower source resistances that are likely to be encountered.

Note that the value of source resistance is the total a.c. resistance across the probe connections, taking into account any parallel paths.

3.3. D.C. MEASUREMENTS

Performance Data

Voltage Range:	0.1 to 300 volts
Accuracy:	±2% of full scale
Input Resistance:	90 MΩ

Connections

Use the DC/Ω and COM leads for d.c. measurements. Since the COM lead is isolated from the Voltmeter chassis by a resistance of 22 MΩ, it does not necessarily have to be connected to earth on the unit under test, but must always be connected to the point nearer to earth potential to prevent the input resistance being shunted by the 22 MΩ isolating resistor.

Use the '+' position of the Selector when the DC/Ω lead is the more positive, and the '-' position when it is more negative.

Setting Zero

Adjust the SET ZERO control on the 3V DC '+' or '-' range with the d.c. leads short-circuited.

3.4. OHMS MEASUREMENT

Performance Data

Range:	50 ohms to 5 MΩ

Connections

Use the DC/Ω and COM leads for ohms measurement. The COM lead is isolated from the voltmeter chassis by a resistance of 22 MΩ and should be connected to the side of the unknown having the lower resistance to earth.

Turn the Selector switch to Ω and the Range switch to x1 kΩ or x100 kΩ as required. On the x1 kΩ range the meter reads up to 50 kΩ, and on the x100 kΩ range up to 5 MΩ.

3. 4. (continued)

Scale Standardization

Short-circuit the DC/Ω and COM leads, and zero the meter with the SET ZERO control on the xl kΩ range.

Then, open-circuit the leads, and adjust the SET Ω control to bring the meter pointer to the full-scale infinity mark.

4. MAINTENANCE

4.1. GENERAL

Before commencing the adjustment or replacement of any component part of the instrument, the user should familiarize himself with the principles dealt with in Section 1, DESCRIPTION.

The Complete Circuit Diagram at the end of the handbook shows all the electrical components of the instrument. Sheet 2 of the Circuit Diagram shows component values, tolerances, and significant ratings.

4.2. ACCESS TO COMPONENTS

To obtain access to the preset components, valve bases, and associated wiring, lay the instrument on its back, and remove the meter surround after extracting the two 4-BA screws, one on each side of the meter.

CAUTION The meter is held in position only by this surround; take care that the meter does not fall out and become damaged if the instrument is stood upright again.

To obtain access to the mains transformer primary tags, voltage stabilizer cells, and other components mounted on the rear of the front panel:-

(1) Slacken, but do not remove, the top and bottom screws near the front edge of each side panel.

(2) Remove the two round-head screws at the bottom of the front panel, one below the engraving 'TF 1300' and one below the serial number.

(3) Swing the complete front panel assembly outwards and upwards from the bottom. The front panel is pivoted about two screws which protrude through the top of the side panels.

4.2.1. The Probe Diode

To obtain access to the probe diode V1, capacitor C1, and resistor R1:-

(1) Remove the probe earth clip. Separate the two halves of the probe by unscrewing the cap from the main casing.

(2) Remove the disk capacitor, C1, from inside the probe cap.

This capacitor is retained in the probe cap with silicone compound, Midland Silicones type MSA. With the probe assembled, the capacitor is held between two domed contacts, one moulded in the probe cap, the other formed by the anode connector for the diode.

(3) Resistor R1 is located in the central hole of the valve holder. One end is soldered to the anode domed contact and the other passes through the unused pin-retaining slit in the holder.

To reassemble the probe unit:-

(1) Place the ceramic disk capacitor so that it sits centrally on the domed contact in the probe cap.

(2) Screw on the probe cap.

4.3. WORKING VOLTAGES

The voltages given in this section for guidance when servicing the instrument were obtained from a representative TF 1300; the voltmeter used for making the measurements was an Avometer model 8, which has a resistance of 20,000 ohms per volt.

Measurements were made with the mains transformer tapping set to 240 volts and using a 240-volt supply.

4.3. (continued)

Power Supply Voltages

Supply	Measured Between:-	Voltage
H.T. a.c.	H.T. 'A' and 'B' tags on T1	320 V.a.c.
L.T. a.c.	L.T. tags on T1	6.3 V.a.c.
H.T. d.c.	across C5	370 V.d.c.

Valve Electrode Voltages

The table below shows d.c. electrode voltages with respect to chassis. These are given for guidance in servicing the instrument; between individual instruments some variation in electrode voltages may be expected due to normal tolerances of valve performance and component values.

Valve No.	Anode Volts d.c.	Grid Volts d.c.	Cathode Volts d.c.
V2a	125	-	5.0
V2b	125	-	5.0
V3a	5.0	-135	-130
V3b	5.0	-135	-130

4.4. REPLACEMENT OF VALVES

With the Voltmeter opened to reveal the underside of the front panel as described in section 4.2, all valves, except the probe diode, are immediately accessible. To obtain access to the probe diode, carry out the procedure described in Section 4.2.1.

Valves may normally be replaced without special selection, although in certain cases replacement may necessitate some readjustment to associated preset components; the table overleaf lists those valves whose replacement is more likely to involve some readjustment and indicates the appropriate realignment procedure.

In order to obtain reasonable zero stability it is advisable to age new valves at their normal working voltage for at least 72 hours before use; this does not apply to the rectifier valve V4.

4. 4. (continued)

Valve No.	Check or Readjust	Section Describing Readjustment
V1	(A.C. zero stability	4. 6. 2.
	(A.C. accuracy	4. 6. 4.
V2)	Complete instrument	4. 6. 1 to
V3)	alignment	4. 6. 4.

4. 5. REPLACEMENT OF VOLTAGE STABILIZER CELLS

The two voltage stabilizer cells, VS1 and VS2, are mounted on the rear wafer of switch S2/S3. These are not storage cells and hence are not subject to discharge. They have an average life expectancy of 10, 000 working hours and, therefore, will seldom require replacement; should this become necessary, the following points should be borne in mind:-

(a) Note the connections of the existing cells before removal; the positive lead is marked with a red spot and is the lead that is attached to the smaller diameter plate of the cell.

(b) Reconnect the replacement cells, observing the correct polarity.

(c) When resoldering the connections, use a thermal shunt on the cell lead to prevent damage to the main body of the cell.

4. 6. ADJUSTMENT OF INTERNAL PRESET COMPONENTS

The following sections give details of the procedures for adjusting the seven preset potentiometers behind the meter surround; five of these preset resistors, those mounted on flat bakelite strip, have their sliders fixed after adjustment by the application of a small amount of polystyrene cement. No attempt should be made to move the potentiometer sliders before dissolving the cement by the application of a drop of acetone or other suitable solvent.

All the preset potentiometers are immediately accessible on removal of the meter surround - see cautionary note in Section 4. 2.

4.6. (continued)

The five flat-strip potentiometers are mounted on the component board below the meter cut-out; the remaining two are rotary types mounted one on either side of the component board. Reading from left to right, the potentiometer circuit references are:- RV9, RV6, RV5, RV2, RV1, RV7 and RV3.

4.6.1. Adjustment of D.C. Zero Preset

The d.c. zero preset, RV9, is adjusted for meter zero with the main SET ZERO control at mid-travel.

(1) Turn the Selector switch to OFF and set the mechanical meter zero.

(2) Adjust the SET ZERO control to mid-travel.

(3) Using a variable mains transformer, adjust the mains supply voltage to exactly the value indicated by the mains transformer primary connections.

(4) Turn the Selector to DC+ and the Range switch to 3V.

(5) Adjust preset potentiometer RV9 to bring the meter pointer exactly to zero.

4.6.2. Stabilization of A.C. Zero

Optimum a.c. zero stability in the presence of supply voltage variation is accomplished by adjustment of preset potentiometer RV7.

(1) Turn the Selector to OFF and set the mechanical meter zero. Short-circuit the probe input connections.

(2) Short-circuit the 22-MΩ resistor, R19, located adjacent to RV7 on the same tag board.

(3) Using a variable mains transformer, adjust the mains supply voltage to exactly the value indicated by the mains transformer primary connections.

(4) Zero the meter on d.c. and a.c. as described in Section 3.2. Leave the Selector switch set to AC and the Range switch set to 1V.

4. 6. 2. (continued)

(5) Vary the mains supply voltage by ±6% and note the change in meter reading.

(6) If the meter reading increases with increase in mains supply voltage, move the slider of RV7 downwards, i. e. towards the 220-kΩ resistor R23.

(7) If the meter reading decreases with increase in mains supply voltage, move the slider of RV7 upwards.

(8) Repeat operations (5) to (7) until the change in meter zero for a 6% mains supply voltage variation is at a minimum, which should not be greater than ±3% of full-scale deflection.

(9) Remove the short-circuit from across R19.

4. 6. 3. Adjustment of D. C. Full-Scale Deflection

Full-scale deflection on d. c. ranges is set using preset potentiometers RV1, RV2, and RV5.

(1) Turn the Selector to DC+ and the Range switch to 1V.

(2) Adjust the SET ZERO control to bring the meter pointer to zero.

(3) Turn the Range switch to 300V and connect the DC/Ω and COM leads to an accurate 300-volt d. c. supply.

(4) Adjust preset potentiometer RV1 to bring the meter pointer to full-scale deflection.

(5) Disconnect the 300-volt supply. Turn the Selector to DC - and reconnect the 300-volt supply with reversed polarity.

(6) Note the position of the meter pointer.

(7) Readjust preset potentiometer RV1 to equalize any error in full-scale deflection between the DC+ and DC - positions.

(8) Disconnect the DC/Ω and COM leads from the 300-volt supply and connect them to an accurate 100-volt d. c. supply.

4. 6. 3. (continued)

(9) Turn the Range switch to 100V and adjust preset potentiometer RV2 to bring the meter pointer to full-scale deflection.

(10) Check the deflection using a reversed polarity input and readjust RV2 to equalize any errors as before.

(11) Disconnect the DC/Ω and COM leads from the 100-volt supply.

(12) Turn the Range switch to 3V and recheck the zero setting.

(13) Connect the DC/Ω and COM leads to an accurate 3-volt d. c. supply.

(14) Adjust the preset potentiometer RV5 to bring the meter pointer to full-scale deflection.

(15) Check the deflection using a reversed polarity input and readjust RV5 to equalize any errors as before.

4. 6. 4. Adjustment of A. C. Full-Scale Deflection

Full-scale deflection on a. c. ranges is set using preset potentiometers RV3 and RV6.

(1) Zero the meter on d. c. and a. c. as described in Section 3. 2. Leave the Selector switch set to AC.

(2) Turn the Range switch to 100V.

(3) Remove the short-circuit from the probe input and connect the probe Hi and Lo terminations to an undistorted 1-kc/s source of 100 volts amplitude.

(4) Adjust preset potentiometer RV3 to bring the meter pointer to full-scale deflection.

(5) Disconnect the external voltage source. Turn the Range switch to 1V, recheck the zero setting, and re-adjust the SET ZERO control if necessary.

(6) Connect the probe input to an undistorted 1-kc/s source of 1 volt amplitude.

4. 6. 4. (continued)

(7) Adjust preset potentiometer RV6 to bring the meter pointer to full-scale deflection.

(8) Check the accuracy of full-scale deflection on all the remaining ranges.

DECIBEL CONVERSION TABLE

Ratio Down			*Ratio Up*	
VOLTAGE	*POWER*	*DECIBELS*	*VOLTAGE*	*POWER*
1·0	1·0	**0**	1·0	1·0
·9886	·9772	**·1**	1·012	1·023
·9772	·9550	**·2**	1·023	1·047
·9661	·9333	**·3**	1·035	1·072
·9550	·9120	**·4**	1·047	1·096
·9441	·8913	**·5**	1·059	1·122
·9333	·8710	**·6**	1·072	1·148
·9226	·8511	**·7**	1·084	1·175
·9120	·8318	**·8**	1·096	1·202
·9016	·8128	**·9**	1·109	1·230
·8913	·7943	**1·0**	1·112	1·259
·8710	·7586	**1·2**	1·148	1·318
·8511	·7244	**1·4**	1·175	1·380
·8318	·6918	**1·6**	1·202	1·445
·8128	·6607	**1·8**	1·230	1·514
·7943	·6310	**2·0**	1·259	1·585
·7762	·6026	**2·2**	1·288	1·660
·7586	·5754	**2·4**	1·318	1·738
·7413	·5495	**2·6**	1·349	1·820
·7244	·5248	**2·8**	1·380	1·905
·7079	·5012	**3·0**	1·413	1·995
·6683	·4467	**3·5**	1·496	2·239
·6310	·3981	**4·0**	1·585	2·512
·5957	·3548	**4·5**	1·679	2·818
·5623	·3162	**5·0**	1·778	3·162
·5309	·2818	**5·5**	1·884	3·548
·5012	·2512	**6**	1·995	3·981
·4467	·1995	**7**	2·239	5·012
·3981	·1585	**8**	2·512	6·310
·3548	·1259	**9**	2·818	7·943
·3162	·1000	**10**	3·162	10·000
·2818	·07943	**11**	3·548	12·59
·2512	·06310	**12**	3·981	15·85
·2239	·05012	**13**	4·467	19·95
·1995	·03981	**14**	5·012	25·12
·1778	·03162	**15**	5·623	31·62

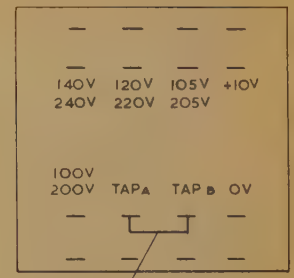
DECIBEL CONVERSION TABLE

Ratio Down			*Ratio Up*	
VOLTAGE	*POWER*	*DECIBELS*	*VOLTAGE*	*POWER*
·1585	·02512	16	6·310	39·81
·1413	·01995	17	7·079	50·12
·1259	·01585	18	7·943	63·10
·1122	·01259	19	8·913	79·43
·1000	·01000	20	10·000	100·00
·07943	·006310	22	12·59	158·5
·06310	·003981	24	15·85	251·2
·05012	·002512	26	19·95	398·1
·03981	·001585	28	25·12	631·0
·03162	·001000	30	31·62	1,000
·02512	·0006310	32	39·81	1,585
·01995	·0003981	34	50·12	2,512
·01585	·0002512	36	63·10	3,981
·01259	·0001585	38	79·43	6,310
·01000	·0001000	40	100·00	10,000
·007943	·00006310	42	125·9	15,850
·006310	·00003981	44	158·5	25,120
·005012	·00002512	46	199·5	39,810
·003981	·00001585	48	251·2	63,100
·003162	·00001000	50	316·2	100,000
·002512	$6{\cdot}320 \times 10^{-6}$	52	398·1	158,500
·001995	$3{\cdot}981 \times 10^{-6}$	54	501·2	251,200
·001585	$2{\cdot}512 \times 10^{-6}$	56	631·0	398,100
·001259	$1{\cdot}585 \times 10^{-6}$	58	794·3	631,000
·001000	10^{-6}	60	1,000	10^{6}
·0005623	$3{\cdot}162 \times 10^{-7}$	65	1,778	$3{\cdot}162 \times 10^{6}$
·0003162	10^{-7}	70	3,162	10^{7}
·0001778	$3{\cdot}162 \times 10^{-8}$	75	5,623	$3{\cdot}162 \times 10^{7}$
·0001000	10^{-8}	80	10,000	10^{8}
·00005623	$3{\cdot}162 \times 10^{-9}$	85	17,780	$3{\cdot}162 \times 10^{8}$
·00003162	10^{-9}	90	31,620	10^{9}
·00001000	10^{-10}	100	100,000	10^{10}
$3{\cdot}162 \times 10^{-6}$	10^{-11}	110	316,200	10^{11}
10^{-6}	10^{-12}	120	10^{6}	10^{12}
$3{\cdot}162 \times 10^{-7}$	10^{-13}	130	$3{\cdot}162 \times 10^{6}$	10^{13}
10^{-7}	10^{-14}	140	10^{7}	10^{14}

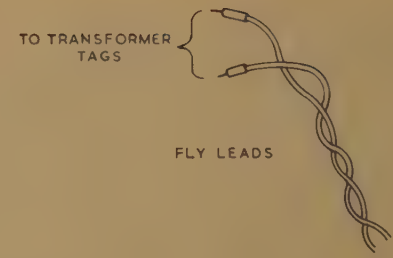
MAINS INPUT CONNECTIONS
100-150/200-250 VOLT PRI.
TRANSFORMERS

FIGURE 1

200-250 VOLTS
MAINS SUPPLIES



SOLDERED LINK FOR 100-150 VOLTS OPERATION
RECONNECT AS IN FIGURE 2

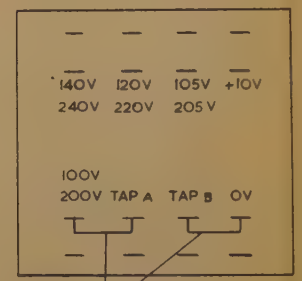


A ARRANGEMENT OF PRIMARY SOLDER TAG CONNECTIONS ON MAINS TRANSFORMER

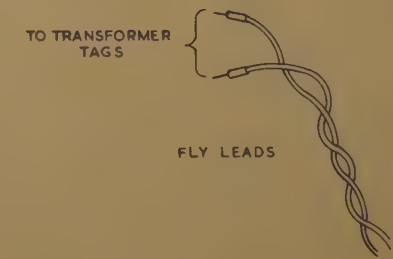
B FLY-LEAD CONNECTIONS
CONNECT THE FLY-LEADS TO GIVE A COMBINATION TO SUIT MAINS VOLTAGE.
ONE FLY-LEAD MUST GO TO EITHER '+10' OR '0' TAP

FIGURE 2

100-150 VOLTS
MAINS SUPPLIES



SOLDERED LINKS FOR 200-250 VOLTS OPERATION
RECONNECT AS IN FIGURE 1



MAINS INPUT CONNECTIONS

MARCONI INSTRUMENTS LIMITED							
DRN	G.R.G.	DATE	21-5-58	CHKD		ISSUE	2
STOCK LIST				DRG NO	TLC 28392		

REF	DESCRIPTION	STOCK LIST
	RESISTORS	
R	7·5MΩ ±5%	
R2	7·5MΩ ±5%	
R3	5·1MΩ ±5%	
R4	22MΩ ±10%	
R5	6·8MΩ ±5%	
R6	2·2MΩ ±1%	
R7	10MΩ ±5%	
R8	1·5KΩ ±0·1%	
R9	7·5MΩ ±1%	
R10	27MΩ ±1%	
R11	99·3KΩ ±1%	
R12	80·0Ω ±1%	
R13	3·814KΩ ±1%	
R14	36·8KΩ ±1%	
R15	119·6KΩ ±1%	
R16	411·0KΩ ±1%	
R17	51KΩ ±2%	
R18	51KΩ ±2%	
R19	22MΩ ±10%	
R20	1·1KΩ ±1%	
R21	2·00KΩ ±1%	
R23	5Ω ±5%	
R23	2·2Ω ±10%	
R24	8·2KΩ ±5% 2W	
R25	330Ω ±10%	
R26	330Ω ±10%	
R27	100KΩ ±5%	
R28	100KΩ ±5%	
R29	5KΩ ±5%	
R30	2·2K ±5%	
R31	33Ω ±5% 1W	
R32	15Ω ±10%	
	RESISTORS VARIABLE	
RV1	2KΩ	
RV2	2KΩ	
RV3	5KΩ	
RV4	2KΩ	
RV5	2KΩ	
RV6	2KΩ	
RV7	2KΩ	
RV8	1KΩ	
RV9	10KΩ	
RV10	2KΩ	

REF	DESCRIPTION	STOCK LIST
	CAPACITORS	
C1	·01MFD +80% −20%	
C2	·01MFD ±25% 1000V	71/TF
C3	·01MFD +80% −20%	
C4	·25MFD ±20% 200V	
C5	8MFD ELECT	
C6	·02 MFD ±10% 3KV	
C7	·001MFD ±20% 600V	

REF	DESCRIPTION	STOCK LIST
	VALVES	
V1	DA90	30/TMS
V2	12AU7	81/TF1300
V3	12AU7	
V4	6X4	84/TF1300
	SWITCHES	
S1	RANGE	22/TF1300
S2	SYSTEM	23/TF1300
S3		
	METER	
M1	200μA	

REF	DESCRIPTION	STOCK LIST
	MISCELLANEOUS	
T1	MAINS TRANSFORMER 1, TF1300	
LP1	6·3V ·15A M.C.C.	83/TF1300
VS1	VOLTAGE STABILIZER 75/TF	
VS2	VOLTAGE STABILIZER 75/TF1300	
PL1	PLUG & MAINS LEAD 2/TF1300	

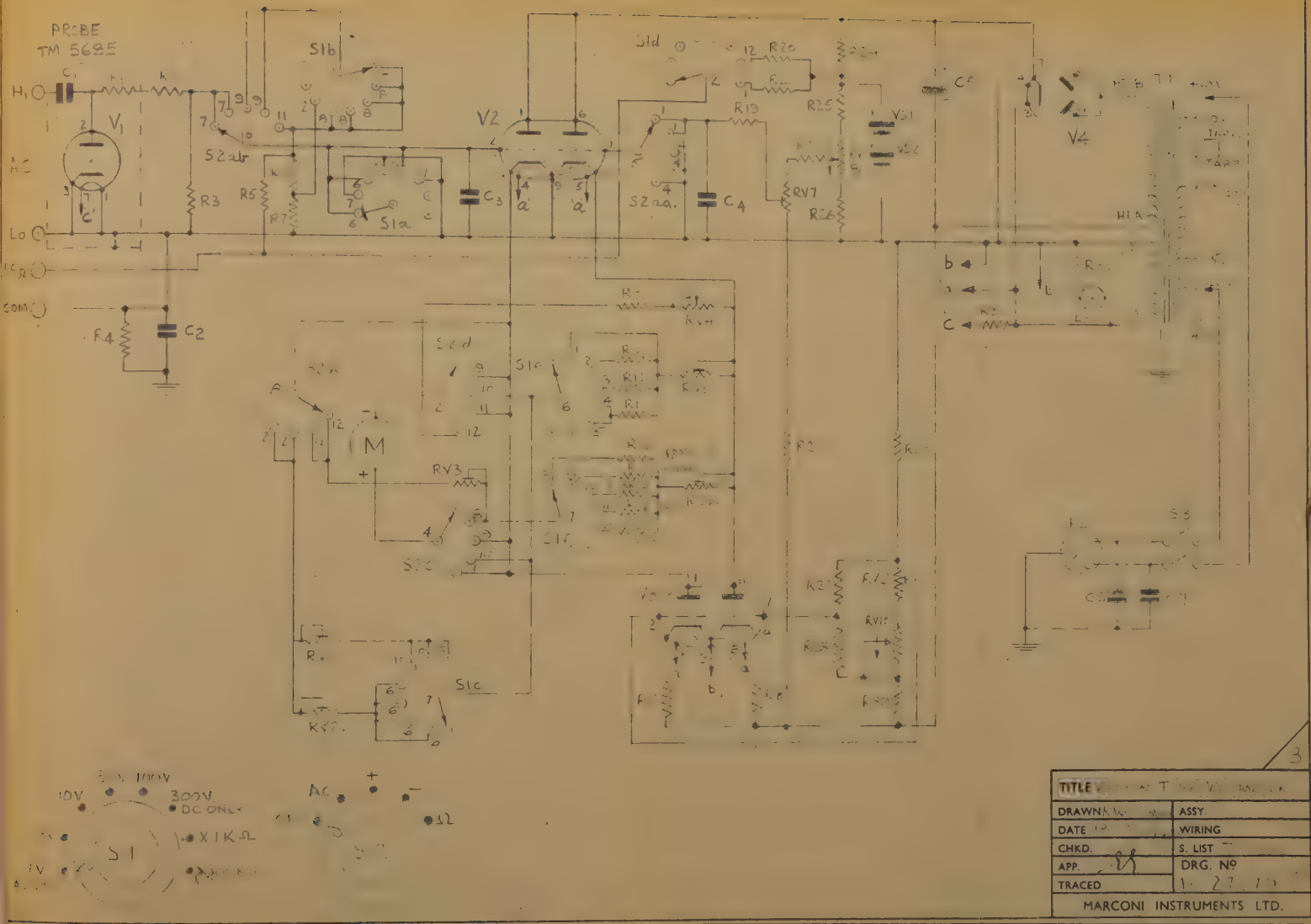
FOR CIRCUIT DIAGRAM SEE SHT. 1

5

TITLE VACUUM TUBE VOLTMETER	
DRAWN K.W.	ASSY.
DATE	WIRING
CHKD.	S. LIST
APP.	DRG. NO SHT
TRACED	TC 27970 2

MARCONI INSTRUMENTS LTD

THIS DRAWING IS COPYRIGHT
AND IS ISSUED ON CONDITION
IT IS NOT COPIED, REPRODUCED
3 FEB 1959



TITLE	
DRAWN	ASSY.
DATE	WIRING
CHKD.	S. LIST
APP.	DRG. Nº
TRACED	

MARCONI INSTRUMENTS LTD.

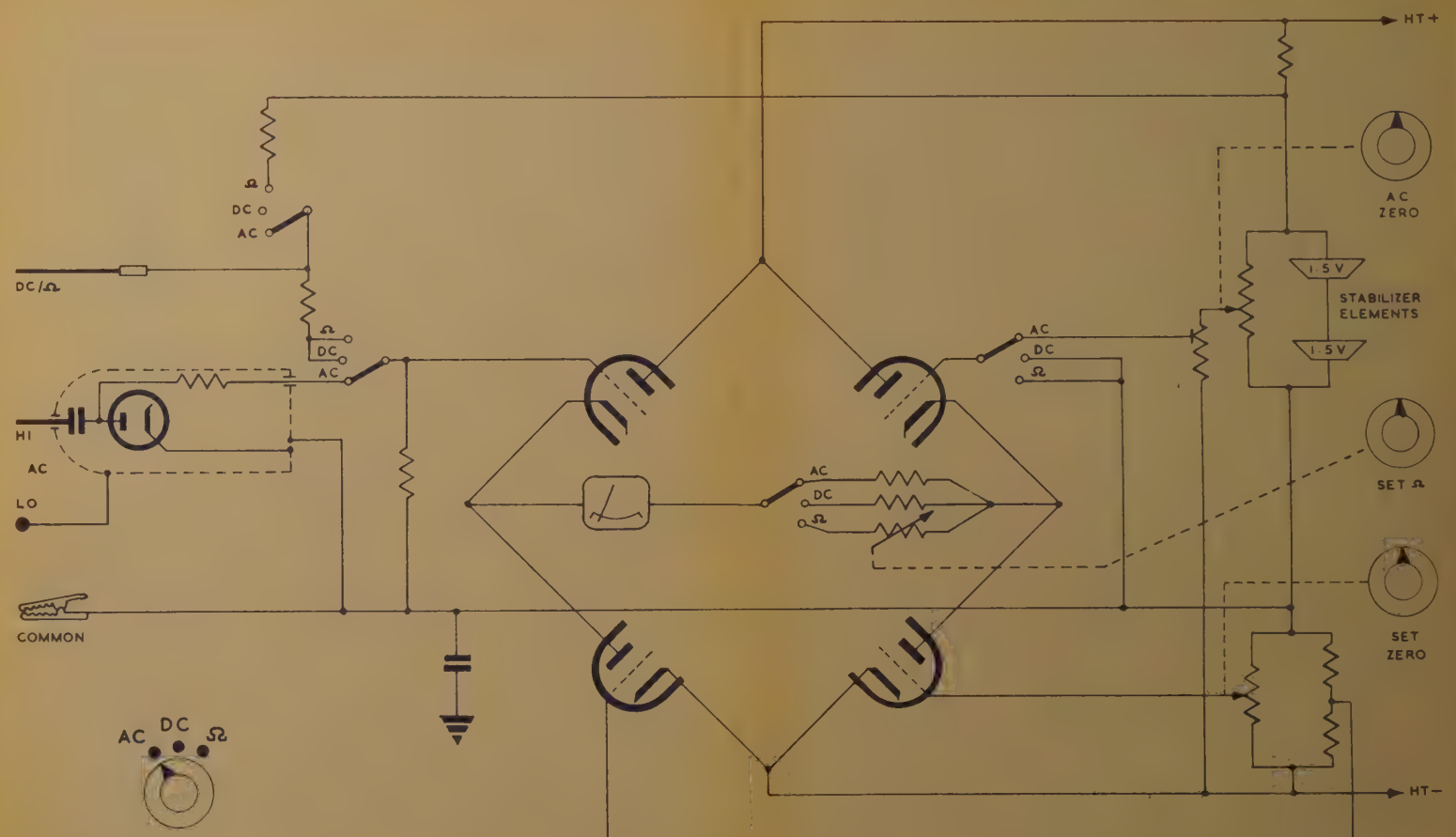
COPYRIGHT
CONDITION
2 FEB 59

FUNCTIONAL DIAGRAM

OF

VACUUM TUBE VOLTMETER

TYPE TF 1300

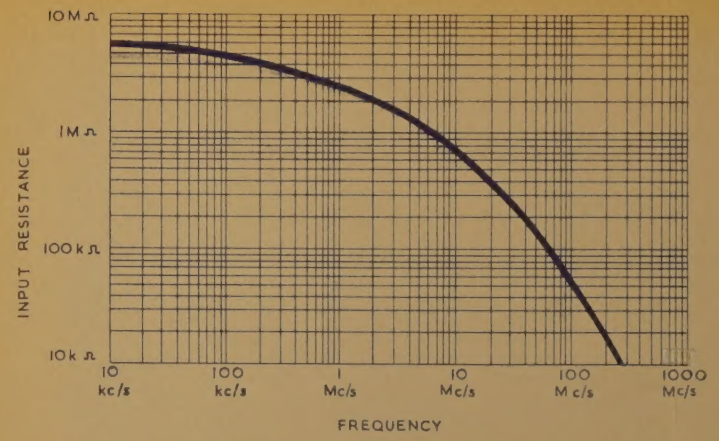


FUNCTIONAL DIAGRAM OF VACUUM TUBE VOLTMETER TYPE TF 1300

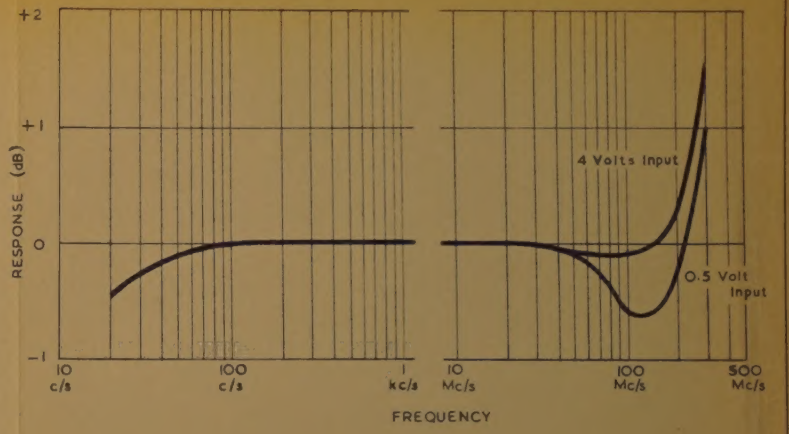
MARCONI INSTRUMENTS LIMITED							
DRN	A. B. R.	DATE	5/58	CHKD		ISSUE	2
STOCK LIST	TF 1300			DRG. NO	TLC 28142		

A.C. PROBE
CHARACTERISTICS

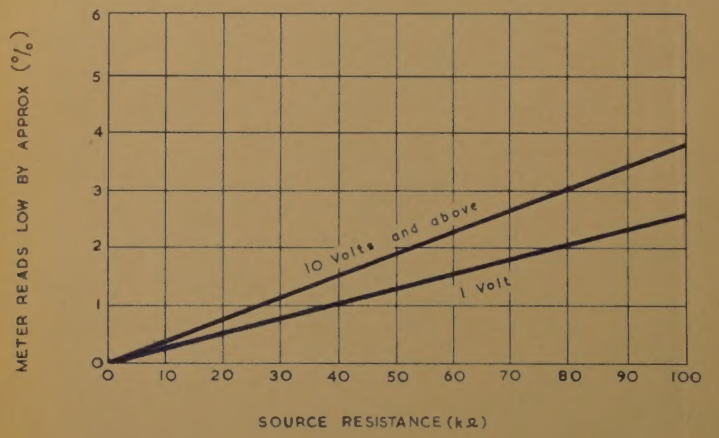
MARCONI INSTRUMENTS LIMITED							
DRN	G. R. G.	DATE	22-5-58	CHKD		ISSUE	1
STOCK LIST	TF1300			DRG No.	TLC 28390		



GRAPH 1. VARIATION OF PROBE INPUT RESISTANCE WITH FREQUENCY



GRAPH 2. TYPICAL FREQUENCY CHARACTERISTIC



GRAPH 3. READING ERROR AT A.F. AS A FUNCTION OF SOURCE RESISTANCE

A.C. PROBE
CHARACTERISTICS

THIS DRAWING IS COPYRIGHT
AND IS ISSUED ON CONDITION
IT IS NOT COPIED, REPRODUCED
30 JAN 1959
OR DISCLOSED TO A THIRD PARTY
WITHOUT THE CONSENT IN WRITING
OF MARCONI INSTRUMENTS LIMITED

www.manualsplus.com
1004463